CLAIMS

1. A method for forming a non-silicon metalloid-oxane and metallo-oxane, or mixed poly(silicon/metallo)oxane polymer networks, or their hydrido, organic, or organometallic derivatives, comprising condensing an alkoxide substrate with another alkoxide material at neutral or near neutral pH using a catalyst comprising a molecule having a nucleophilic group that displaces alkanol from said alkoxide substrate facilitating solvolysis to initiate structure-directed condensation with said another alkoxide, wherein either or both of said alkoxides is selected from the group consisting of organosilicon alkoxides; hydrido-silicon alkoxides; metallo alkoxides; organometallo-alkoxides; hydrido metallo-alkoxides; metalloid alkoxides; organometalloid alkoxides; and hydrido metalloid alkoxides.

2. The method of Claim 1 wherein said structure-directed condensation is by nucleophilic attack.

3. The method of Claim 1 wherein said nucleophilic group forms a transitory intermediate in facilitating solvolysis.

4. The method of Claim 3 wherein said transitory intermediate is covalent.

5. The method of Claim 1 comprising using a group that interacts with said nucleophilic group to increase its nucleophilicity.

6. The method of Claim 5 wherein said interaction is by hydrogen bonding.

7. The method of claim 1 wherein either or both of said alkoxides is selected from:

(a) any of non-silicon metalloid alkoxides, metal alkoxides, inorganic and organic oxygen-containing chelates of silicon, non-silicon metalloids or metals, and inorganic and organic esters, hyrdrolyzable salts, complexes or conjugates of the

hydoxides of silicon, non-silicon metalloids or metals; and

(b) any organic, organometallic or hydrido derivatives of the foregoing.

8. The method of claim 7 wherein either or both of said alkoxides is an organosilicon alkoxide.

9. The method of claim 8 wherein said organosilicon alkoxide is methyl-, phenyl-, or dansylpropyl-triethoxysilane.

10. The method of claim 7 wherein either or both of said alkoxides is a hydrido-silicon alkoxide.

11. The method of claim 10 wherein said hydrido-silicon alkoxide is hydrido-triethoxysilane.

12. The method of claim 7 wherein either or both of said alkoxides is a metallo alkoxide.

13. The method of claim 12 wherein said metallo alkoxide is bis(lactato) titanium.

14. The method of claim 1 wherein either or both of said alkoxides is an organometallo-alkoxide.

15. The method of claim 14 wherein said organometallo-alkoxide is phenyl-bis(lactato) titanium.

16. The method of claim 7 wherein either or both of said alkoxides is a hydrido metallo-alkoxide.

17. The method of claim 16 wherein said hydrido metallo-alkoxide is hydrido-bis(lactato) titanium.

18. The method of claim 7 wherein either or both of said alkoxides is a metalloid alkoxide.

19. The method of claim 18 wherein said metalloid alkoxide is tetraorthoethoxygermanate.

20. The method of claim 7 wherein either or both of said alkoxides is an organometalloid alkoxide.

21. The method of claim 20 wherein said organometalloid alkoxide is methyl-, phenyl-, or dansylpropyl-triethoxygermane.

22. The method of claim 7 wherein either or both of said alkoxides is a hydrido metalloid alkoxide.

23. The method of claim 22 wherein said hydrido metalloid alkoxide is hydrido-triethoxygermane.

24. The method of claim 7 wherein there is formed as a product the corresponding non-silicon metalloid-oxane and metallo-oxane, or mixed poly(silicon/metallo)oxane, polymer networks, or their hydrido, organic, or organometallic derivatives

25. The method of Claim 1 wherein said catalyst molecule is selected from proteins, enzymes, peptides, non-peptide-based polymers, small molecules, supramolecular aggregates, filaments, or arrays or assemblies thereof.

26. The method of Claim 25 wherein said catalyst molecule is a protein.

27. The method of Claim 25 wherein said catalyst molecule is an enzyme.

28. The method of Claim 27 wherein said enzyme is a silicatein.

29. The method of Claim 27 wherein said enzyme is a protease.

30. The method of Claim 27 wherein said enzyme is a peptidase.

31. The method of Claim 27 wherein said enzyme is a hydrolase.

32. The method of Claim 31 wherein said hydrolase is selected from the group consisting of amidase, esterase and lipase.

33. The method of Claim 27 wherein said enzyme is a catalytic triad enzyme.

34. The method of Claim 1 wherein said catalyst molecule is a peptide.

35. The method of Claim 34 wherein said peptide contains lysine or poly-lysine.

36. The method of Claim 34 wherein said peptide contains serine or poly-serine.

37. The method of Claim 34 wherein said peptide contains a tyrosine.

38. The method of Claim 34 wherein said peptide contains a histidine.

39. The method of Claim 34 wherein said peptide contains cysteine, oligocysteine or poly-cysteine.

40. The method of Claim 34 wherein said peptide contains a nucleophilic catalytic side-chain

41. The method of Claim 40 wherein said nucleophilic catalytic side-chain is contributed by serine, cysteine, histidine or tyrosine.

42. The method of Claim 34 wherein said peptide contains a hydrogen-bonding amine.

43. The method of Claim 1 wherein said catalyst molecule is a non-peptide-based polymer that operates by a mechanism of catalysis similar to that utilized by silicateins..

44. The method of Claim 43 wherein said non-peptide-based polymer contains a hydrogen-bonding amine and/or a nucleophilic group.

45. The method of Claim 24 wherein said product is a silsesquioxane.

46. The method of Claim 24 wherein said product is a polyorganosiloxane.

47. The method of Claim 24 wherein said product is a polymetallo-oxane.

48. The method of Claim 24 wherein said product is a polyorganometallo-oxane.

49. The method of Claim 24 wherein said product is a polyorganometalloid-oxane.

50. The method of Claim 1 in which said catalyst molecule is self-assembling whereby said structure-directed condensation is provided by a spatial array of structure-directing determinants contained on or within the self-assembling catalyst molecule.

51. The method of Claim 50 in which said spatial array of structure-directing determinants acts in conjunction with the surfaces of any solid support to which said catalyst molecule is attached or in which said catalyst molecule is confined.

52. The method of Claim 50 wherein said catalyst molecule is selected from the group consisting of silicatein, protein, enzyme, peptide, and non-peptide-based polymers, and/or any aggregate, filament, or other assembly thereof.

53. The method of claim 1 in which said nucleophilic group is provided by a hydroxyl or sulfhydryl group.